Fourth Annual Conference on Carbon Capture & Sequestration

Developing Potential Paths Forward Based on the Knowledge, Science and Experience to Date

Sequestration Policy and Feasibility Studies (2)

"Wedge" Analysis of the IPCC SRES Scenarios

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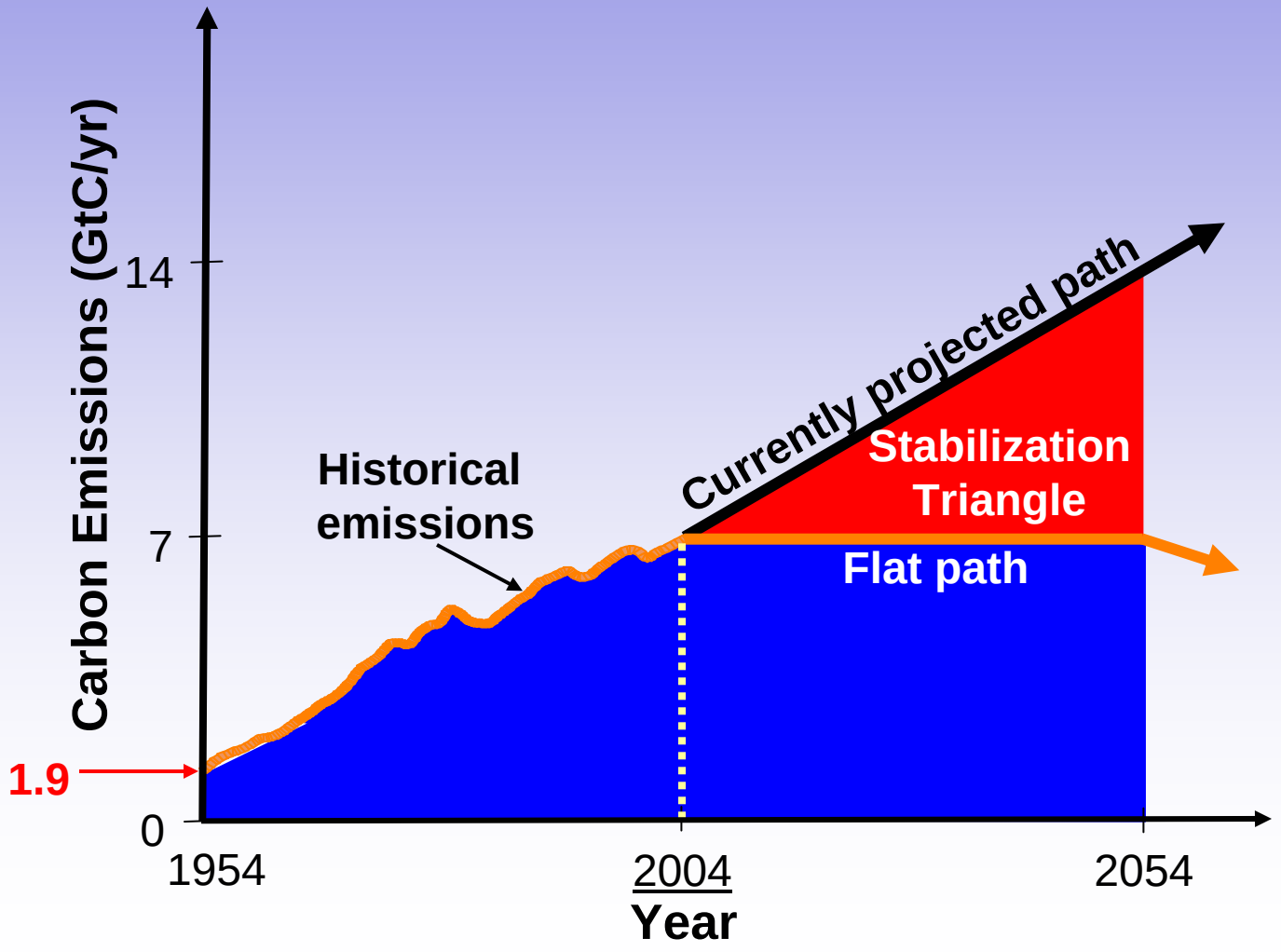
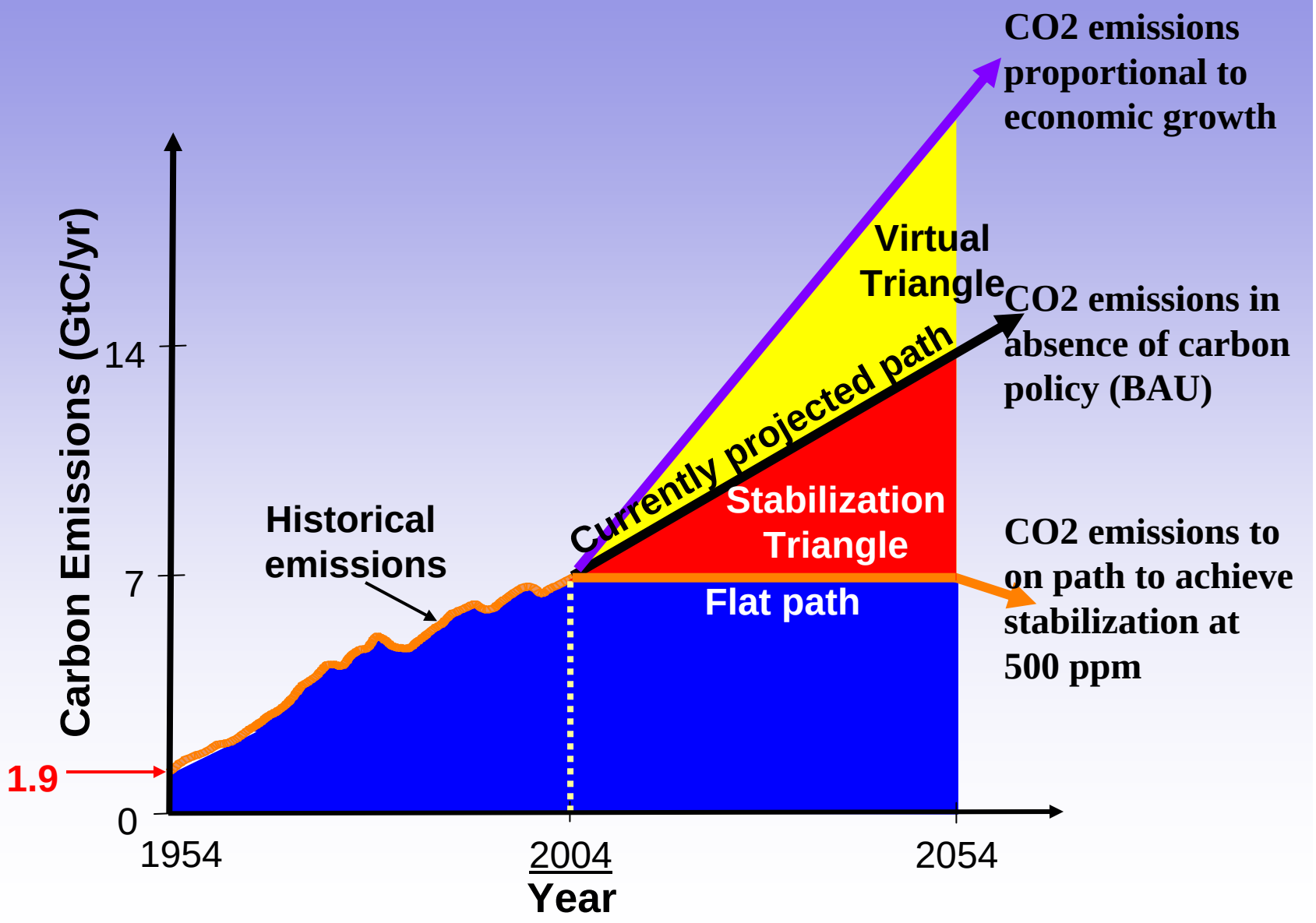
Outline of Talk

- The “wedge model” of the first 50 years of climate stabilization takes a useful shortcut: no details of the baseline are assumed other than the carbon emissions trajectory. Implementing seven “stabilization wedges” puts the world on a 500-ppm stabilization path.
- The shortcut can be illuminated using the SRES scenarios. Each provides detailed information about the many “virtual wedges” (conservation, renewables, etc.) already embedded in the baseline.
- Post-SRES stabilization scenarios, paired with the SRES scenarios, provide a complete picture of virtual and real wedges.
- SRES scenarios are particularly sensitive to assumptions about coal and about technology choice in the developing world. Carbon sequestration plays a large role in Post-SRES stabilization scenarios.

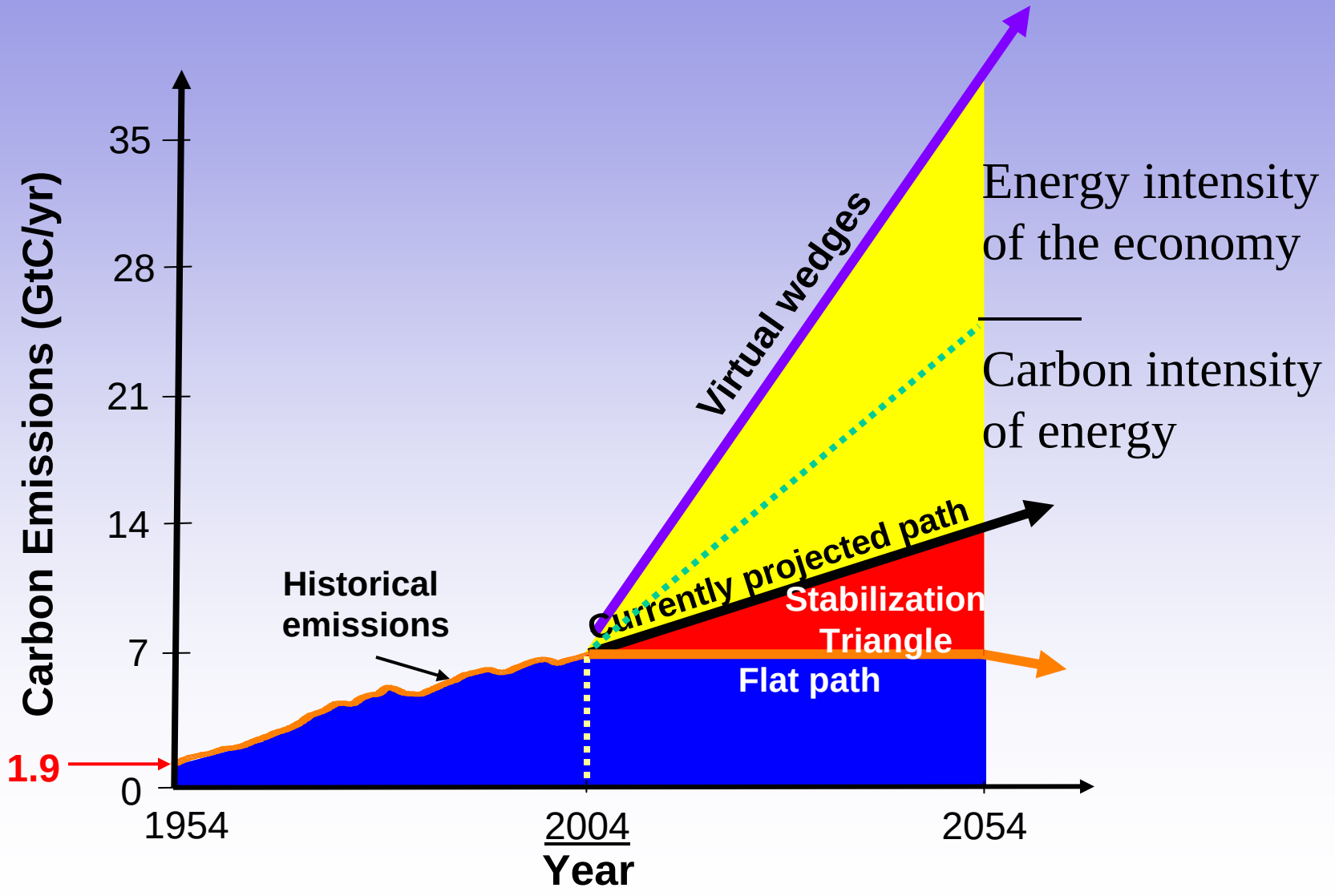
Stabilization Triangle



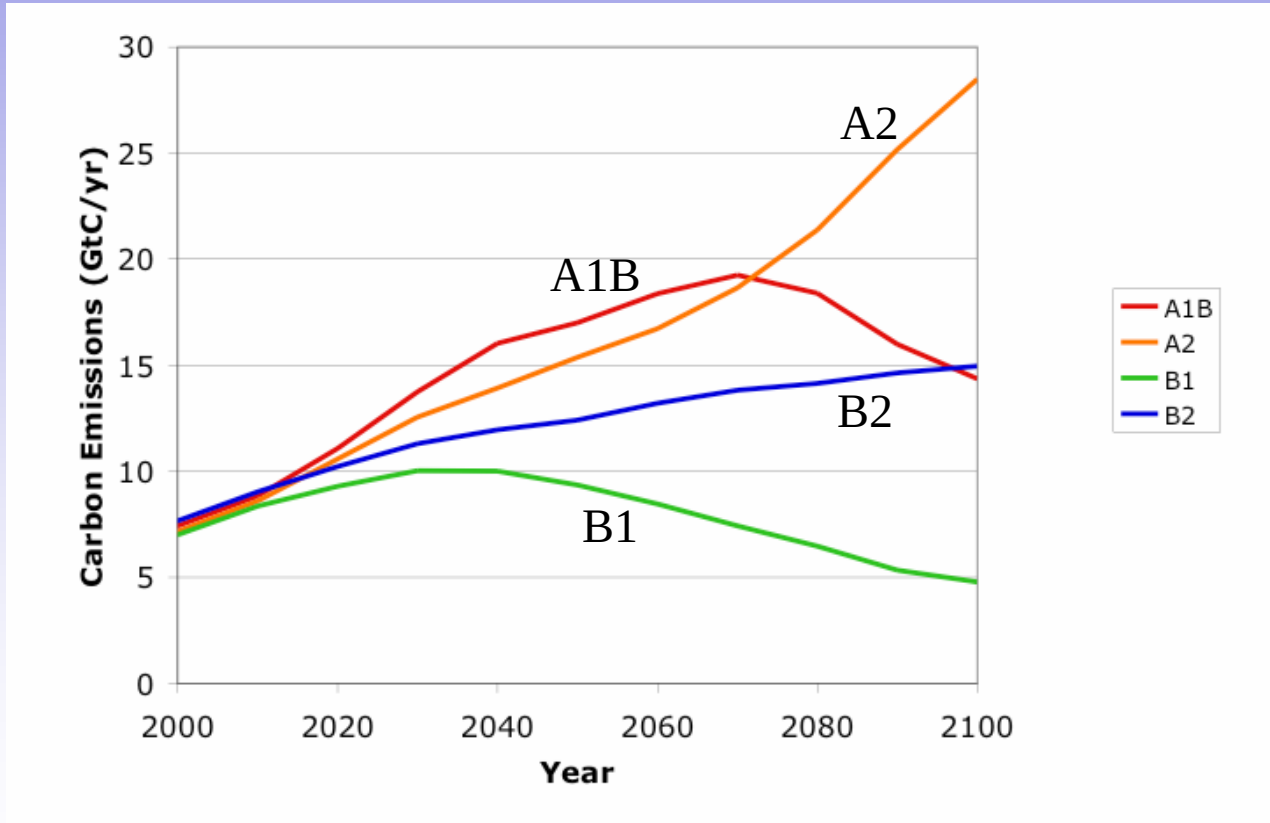
Virtual Triangle



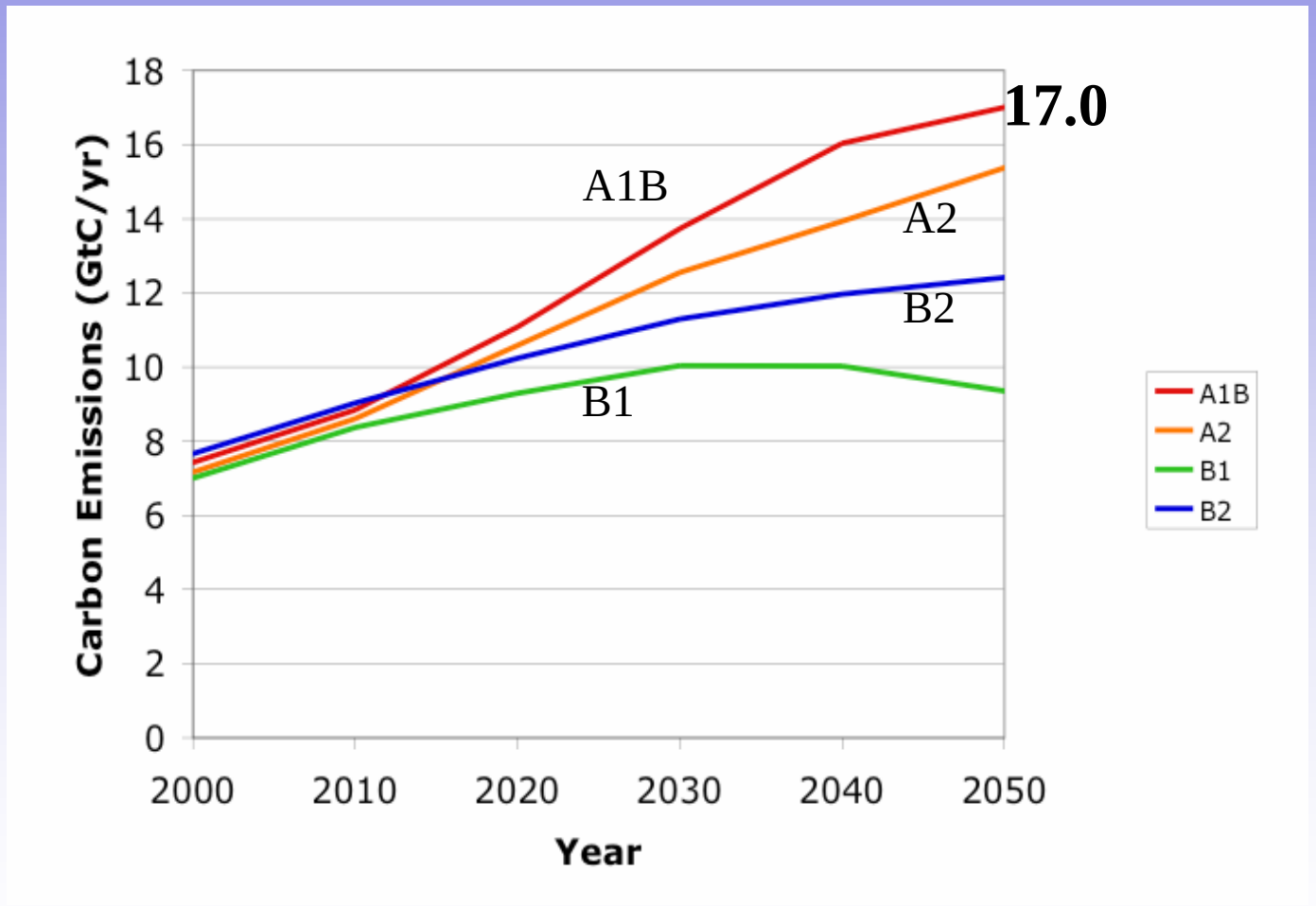
Attribution of virtual triangle to virtual wedges



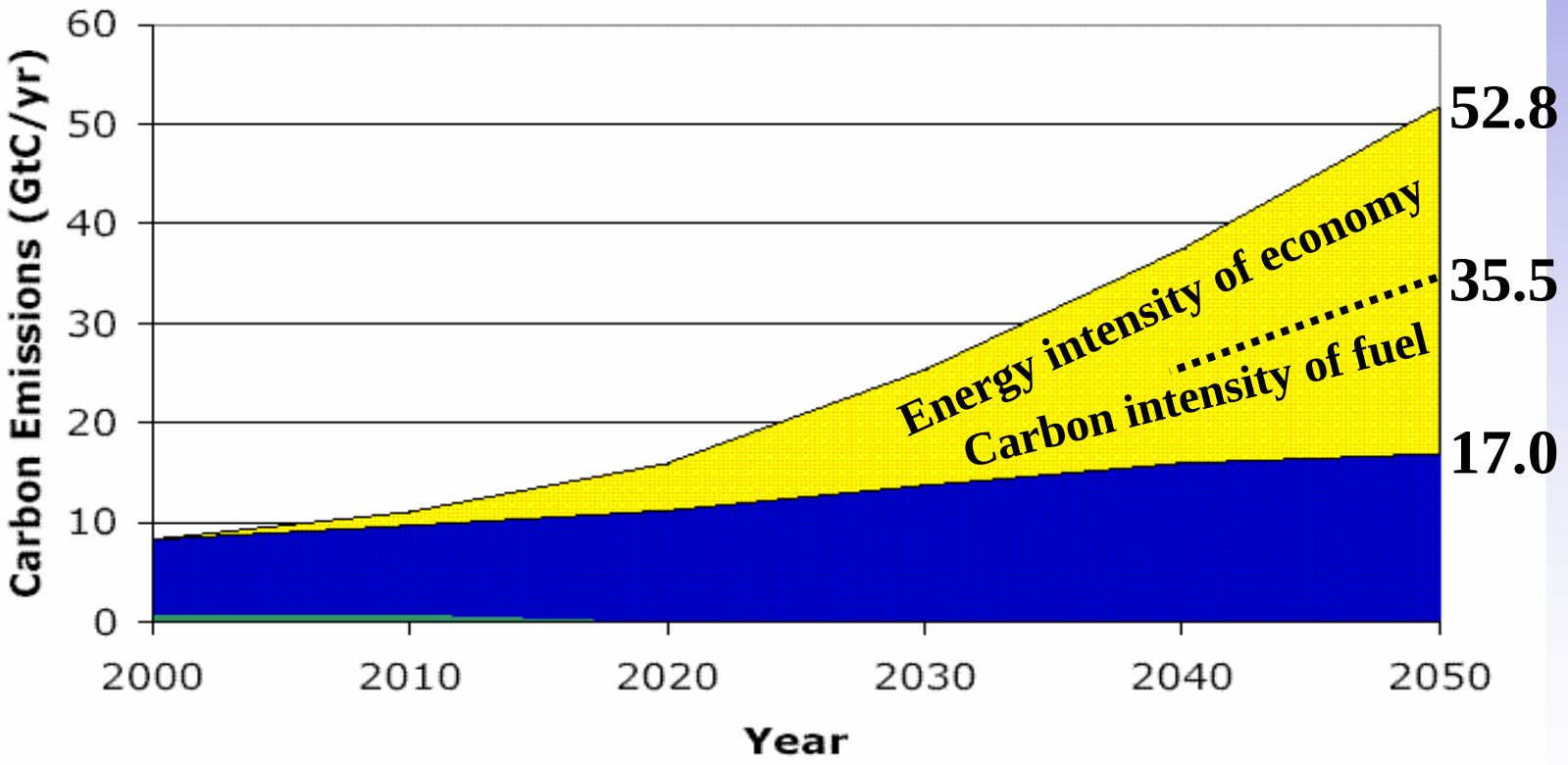
Four SRES scenarios -- through 2100

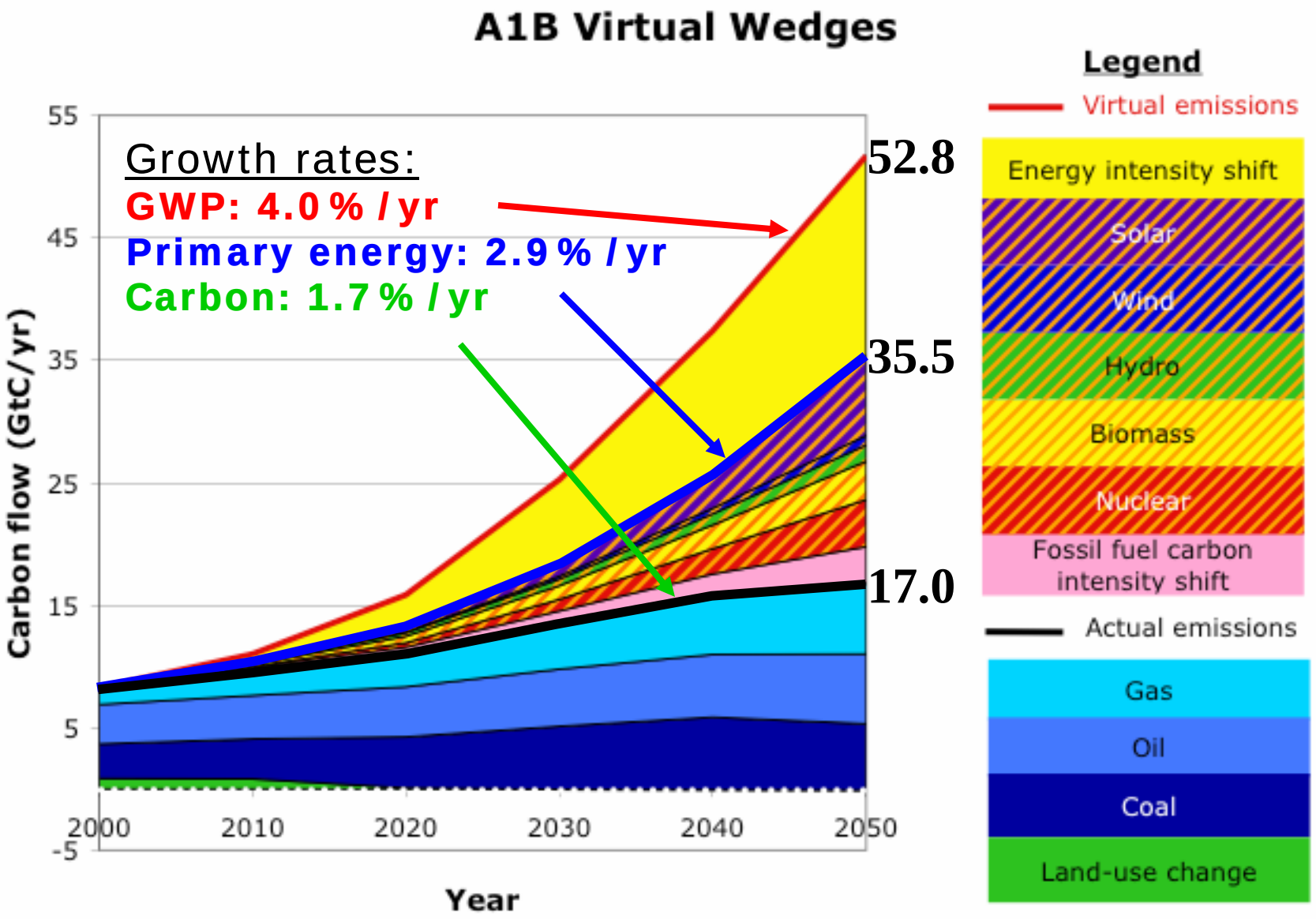


Four SRES Scenarios -- through 2050



A1B Virtual Triangle



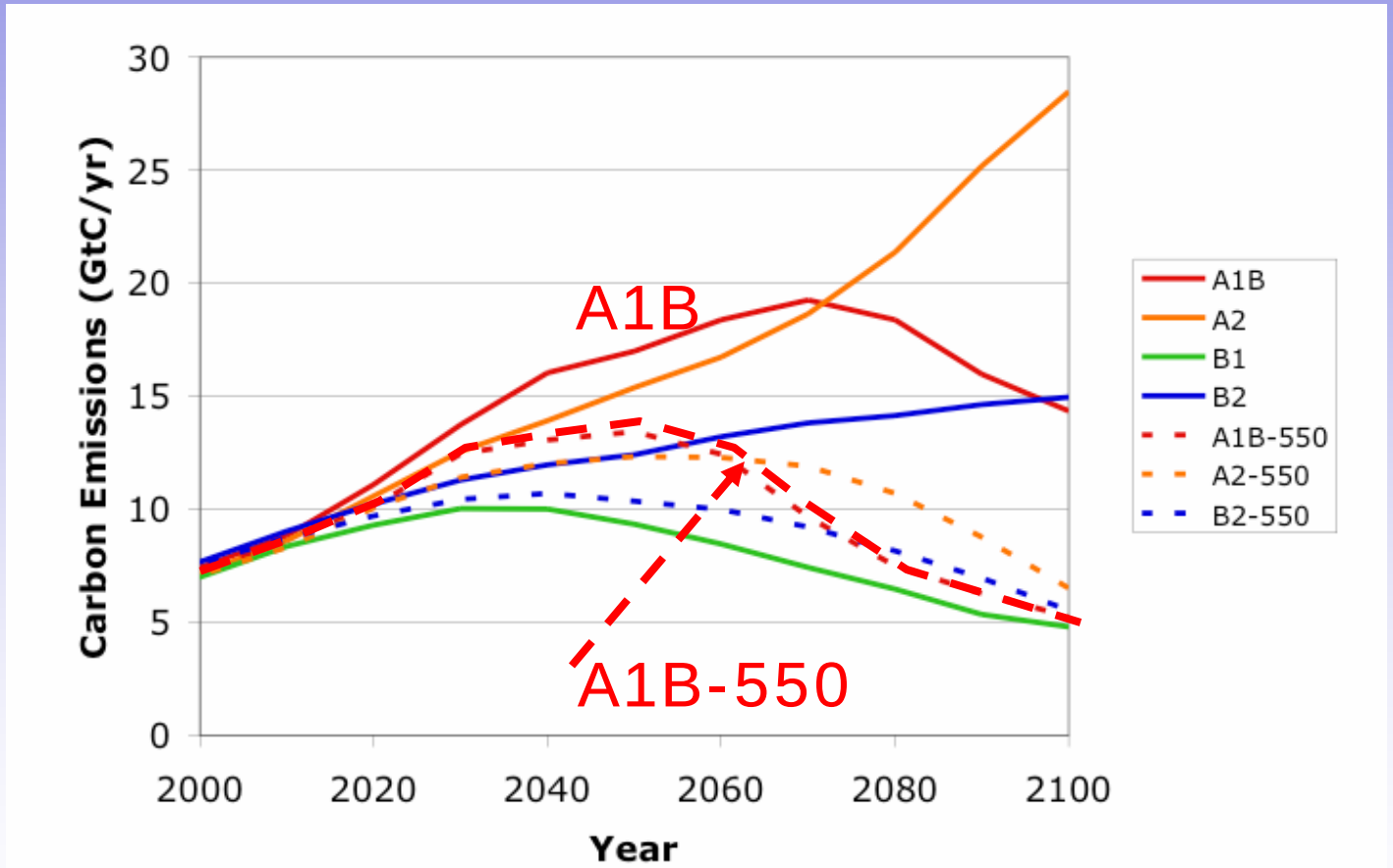

A1B Virtual Wedges
Growth rates:
GWP: 4.0 % / yr
Primary energy: 2.9 % / yr
Carbon: 1.7 % / yr
52.8
35.5
17.0
Carbon flow (GtC/yr)
55
45
35
25
15
5
-5
2000
2010
2020
2030
2040
2050
Year
Legend
Virtual emissions
Energy intensity shift
Solar
Wind
Hydro
Biomass
Nuclear
Fossil fuel carbon intensity shift
Actual emissions
Gas
Oil
Coal
Land-use change

Growth Rates (2000-2050) in the SRES Scenarios

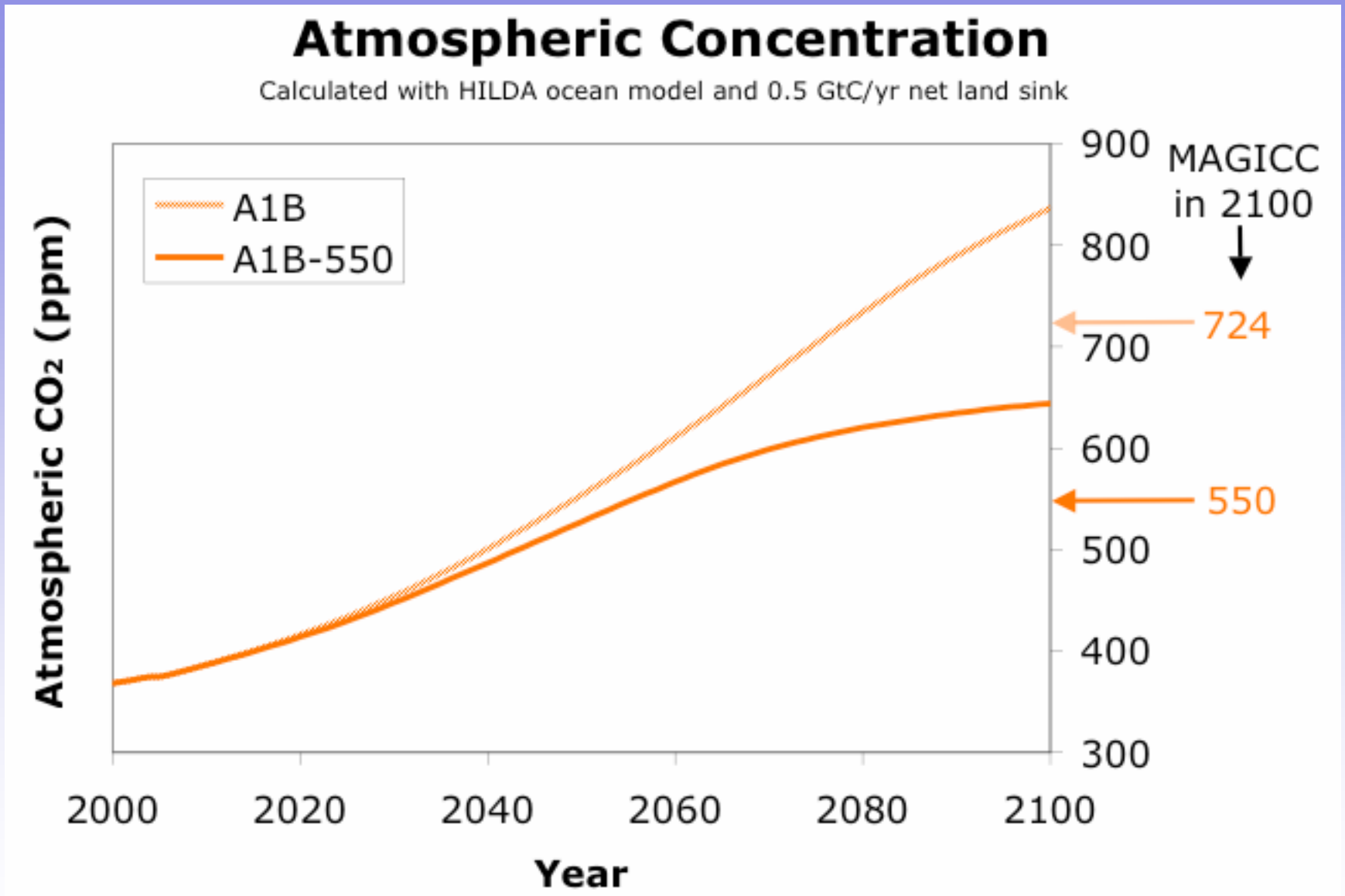
Growth rates are in percent per year	**A1B**	A2	B1	B2
GWP ($)	**3.96**	2.37	3.30	2.74
Primary Energy (P)	**2.88**	2.08	1.91	1.87
Carbon Emissions (C)	**1.67**	1.54	0.58	0.97
Energy Intensity of the Economy: ($-P)	**1.05**	0.28	1.36	0.85
Carbon Intensity of Energy (E-P)	**1.19**	0.53	1.32	0.89
Carbon Intensity of the Economy ($-C)	**2.25**	0.82	2.70	1.75

For A1B, reduction of the energy intensity of the economy and decarbonization of the energy supply are about equally important in reducing carbon emissions, relative to emissions proportional to Gross World Product.

Scenarios Pairs: SRES and Post-SRES (550 ppm stabilization) -- through 2100

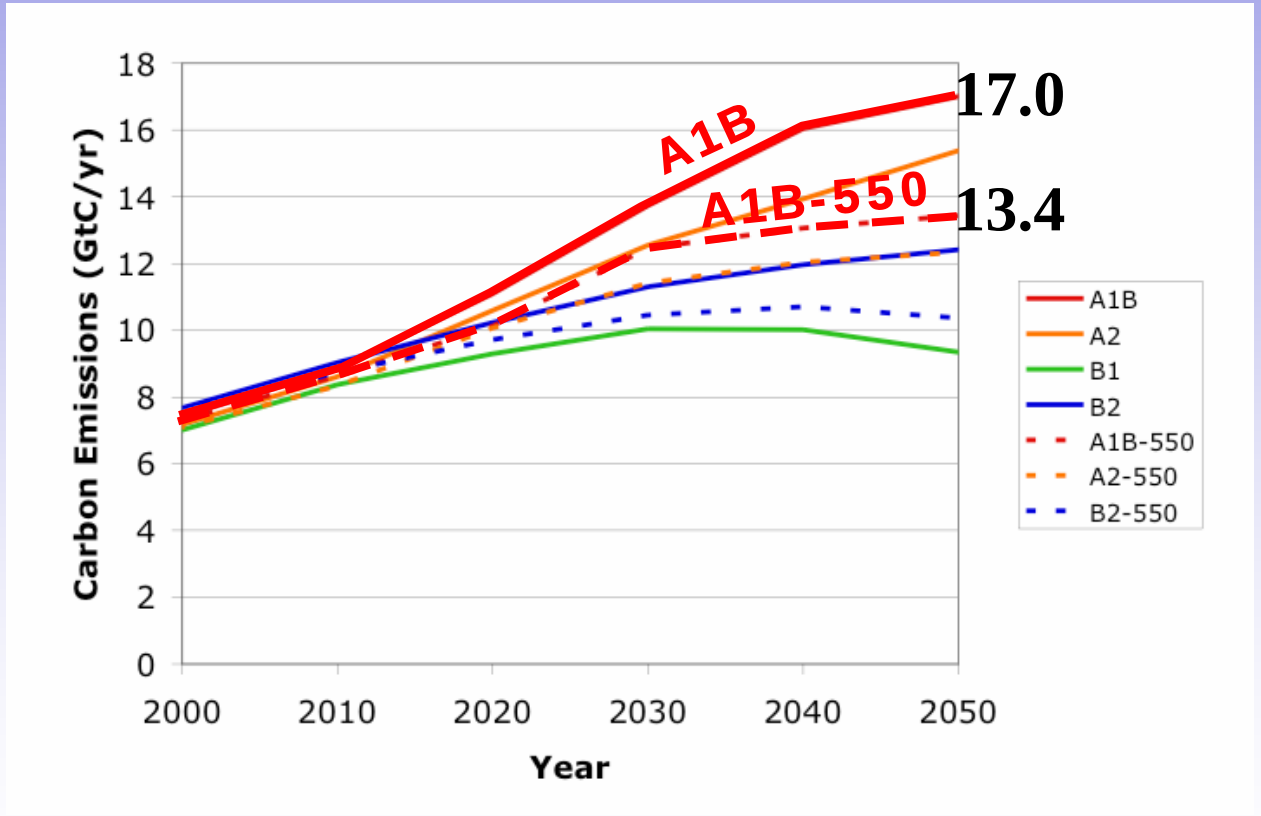


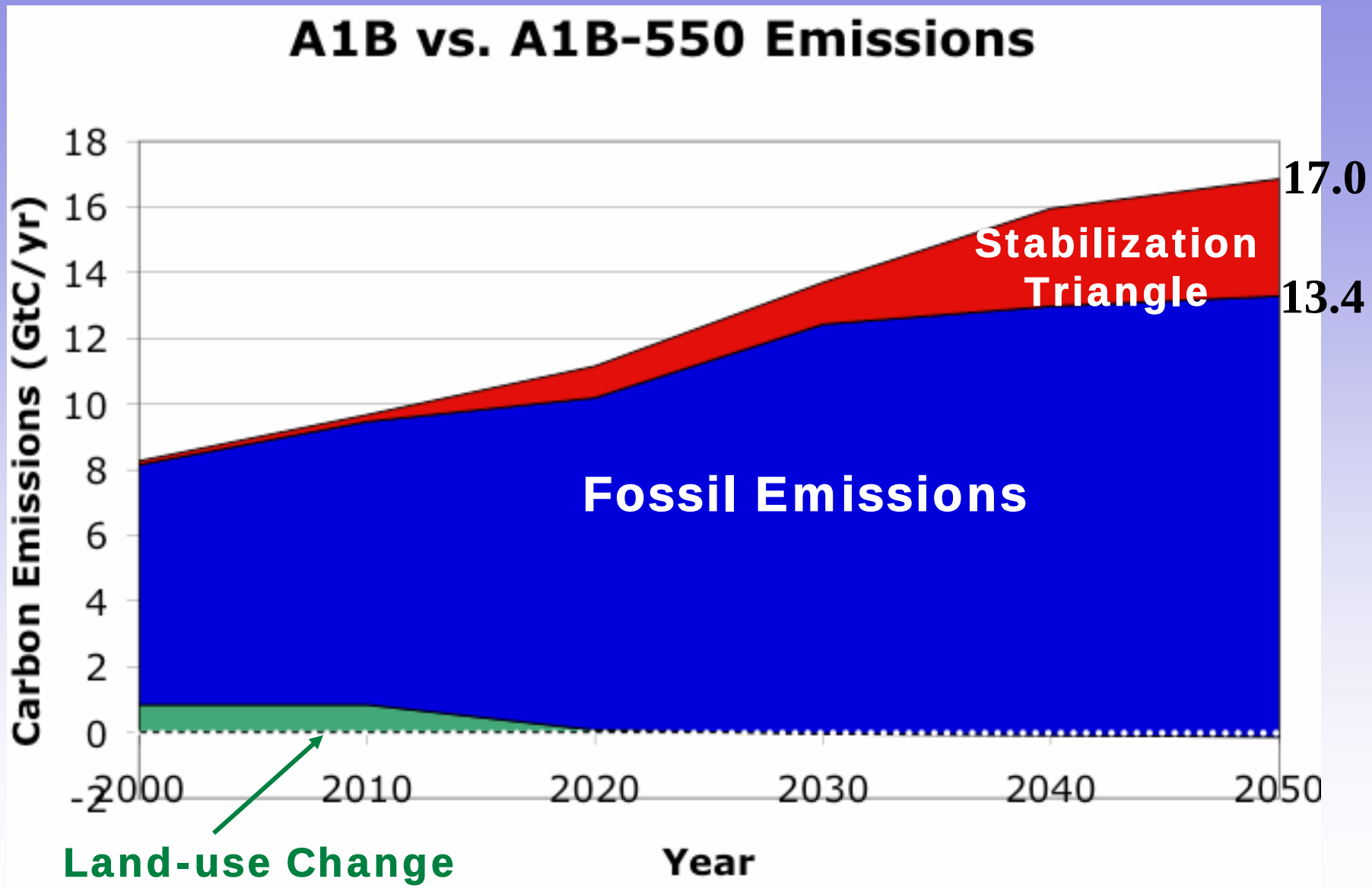
Each SRES scenario has been modified to achieve 550-ppm stabilization by 2100. A1B-550 is the modified version of A1B.

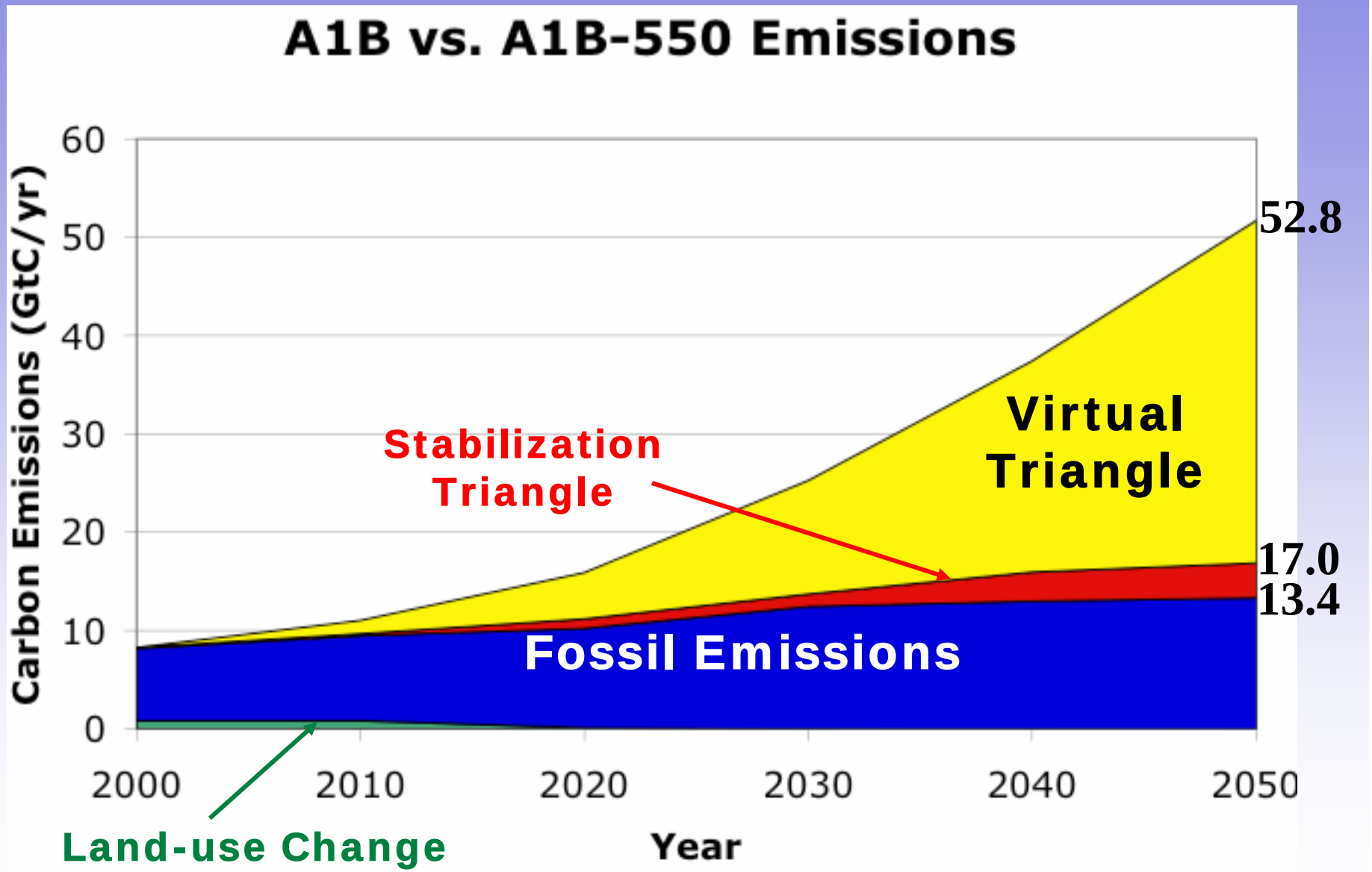


Princeton's CO_2 concentrations in 2100 are ~100 ppm higher, because our land sink is weaker than the one in SRES (MAGICC).

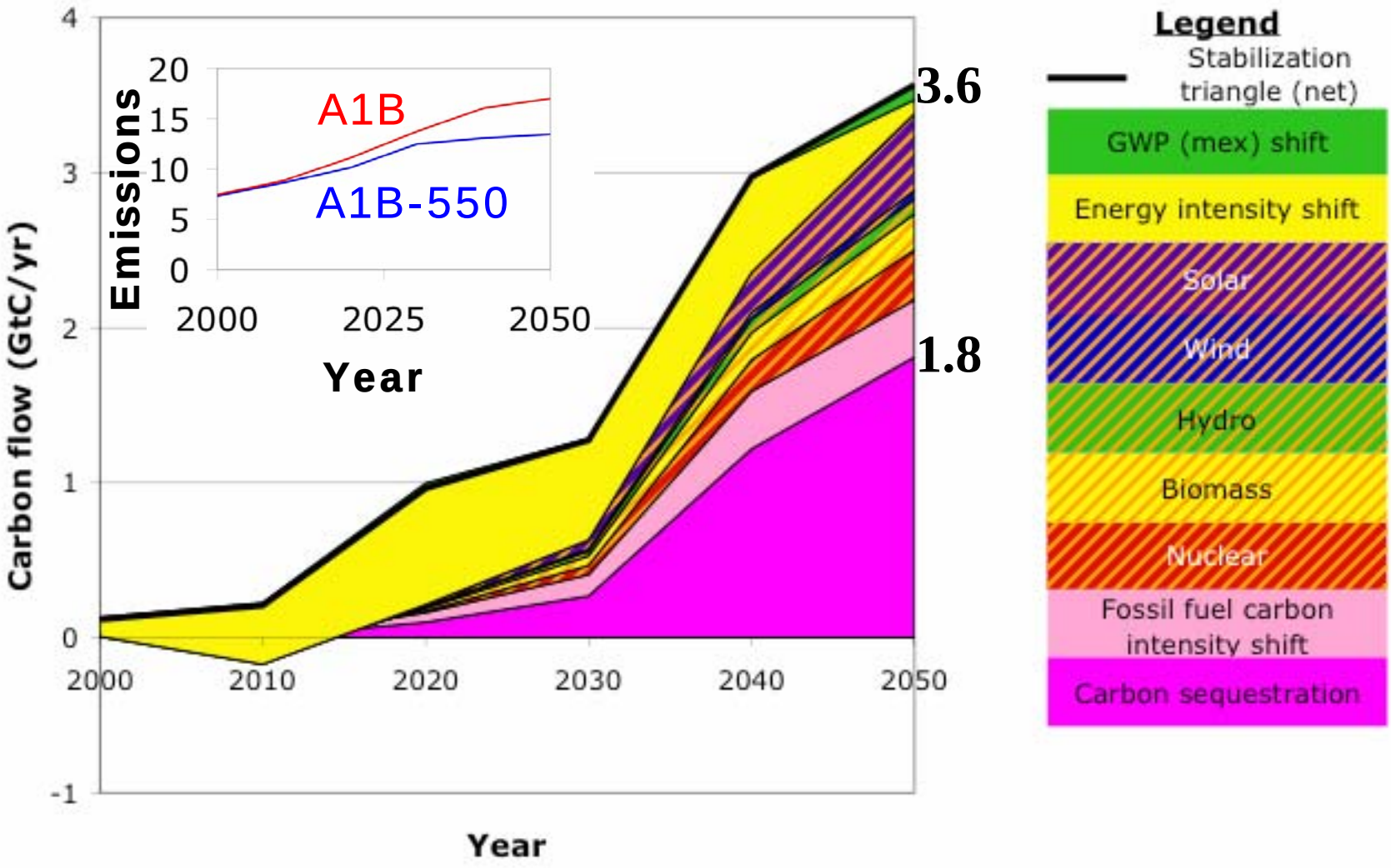
Scenarios Pairs: SRES and Post-SRES (550 ppm stabilization) -- through 2050




A1B vs. A1B-550 Emissions
Carbon Emissions (GtC/yr)
18
16
14
12
10
8
6
4
2
0
-2
2000
2010
2020
2030
2040
2050
Year
17.0
13.4
Stabilization Triangle
Fossil Emissions
Land-use Change


A1B vs. A1B-550 Emissions
Carbon Emissions (GtC/yr)
60
50
40
30
20
10
0
2000
2010
2020
2030
2040
2050
Year
52.8
17.0
13.4
Virtual Triangle
Stabilization Triangle
Fossil Emissions
Land-use Change

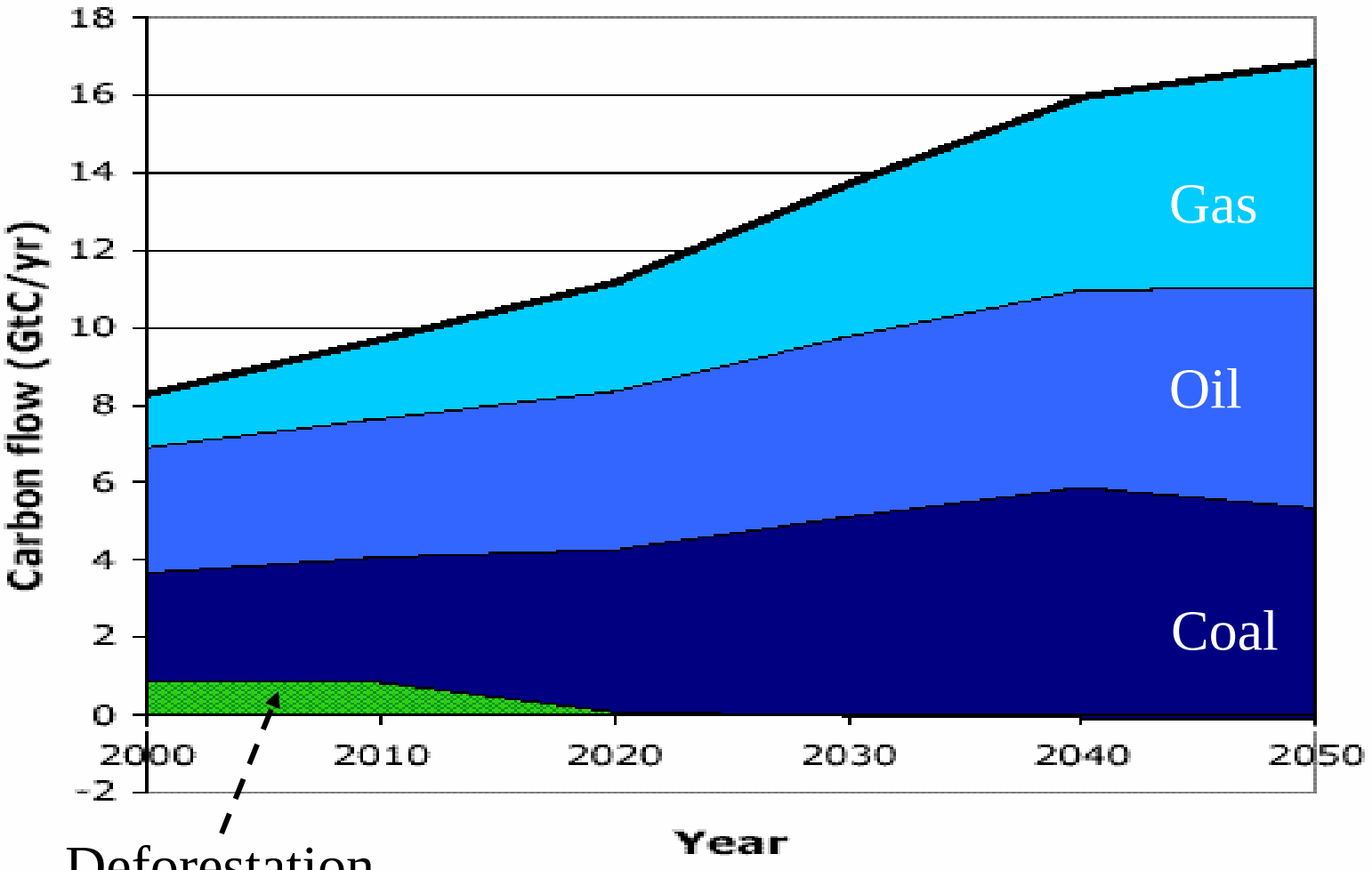
A1B-550 Stabilization Wedges (A1B baseline)



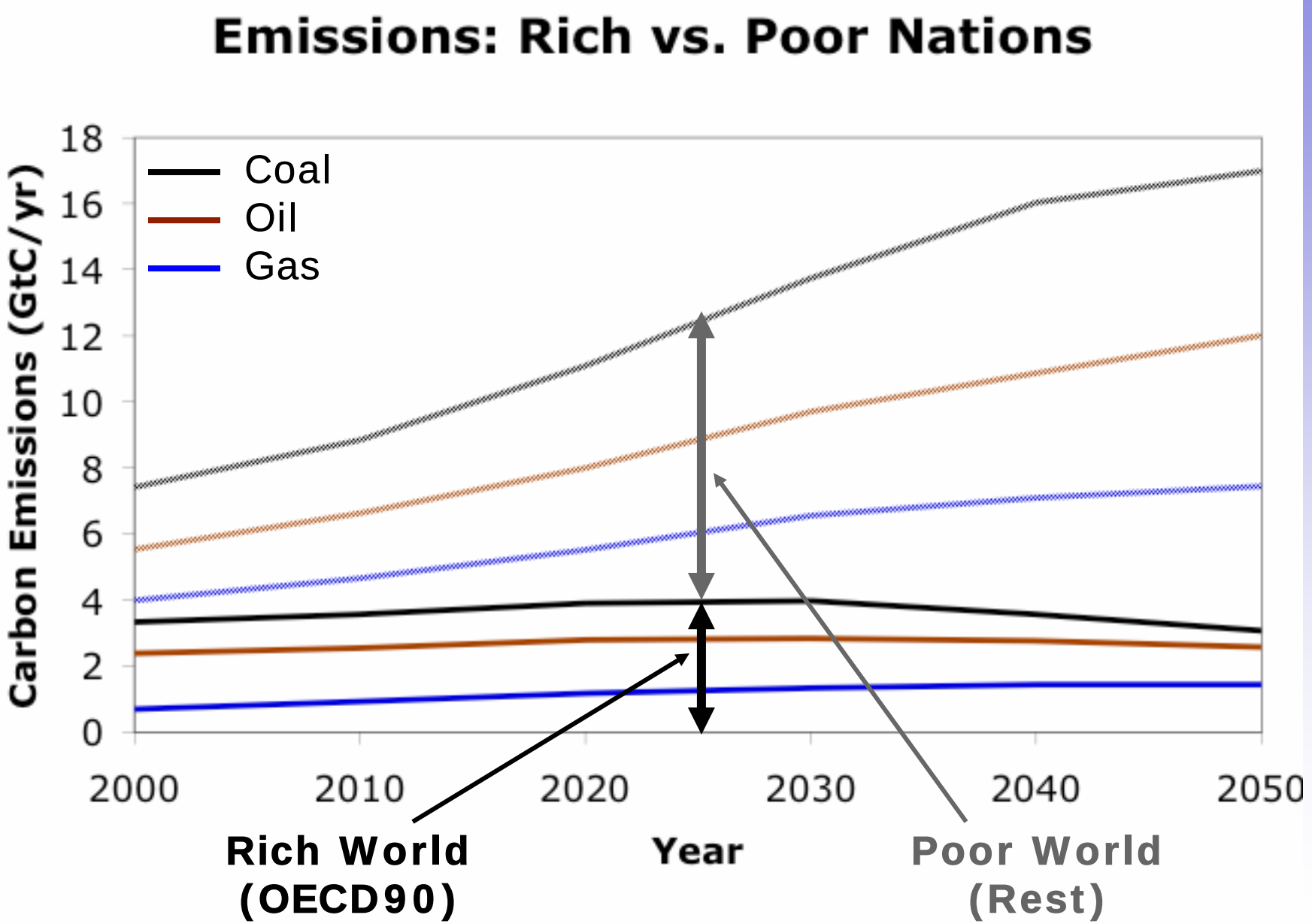
For the A1B/A1B-550 pair, half of the stabilization wedges (2 out of 4) are achieved by carbon sequestration

EXTRA SLIDES

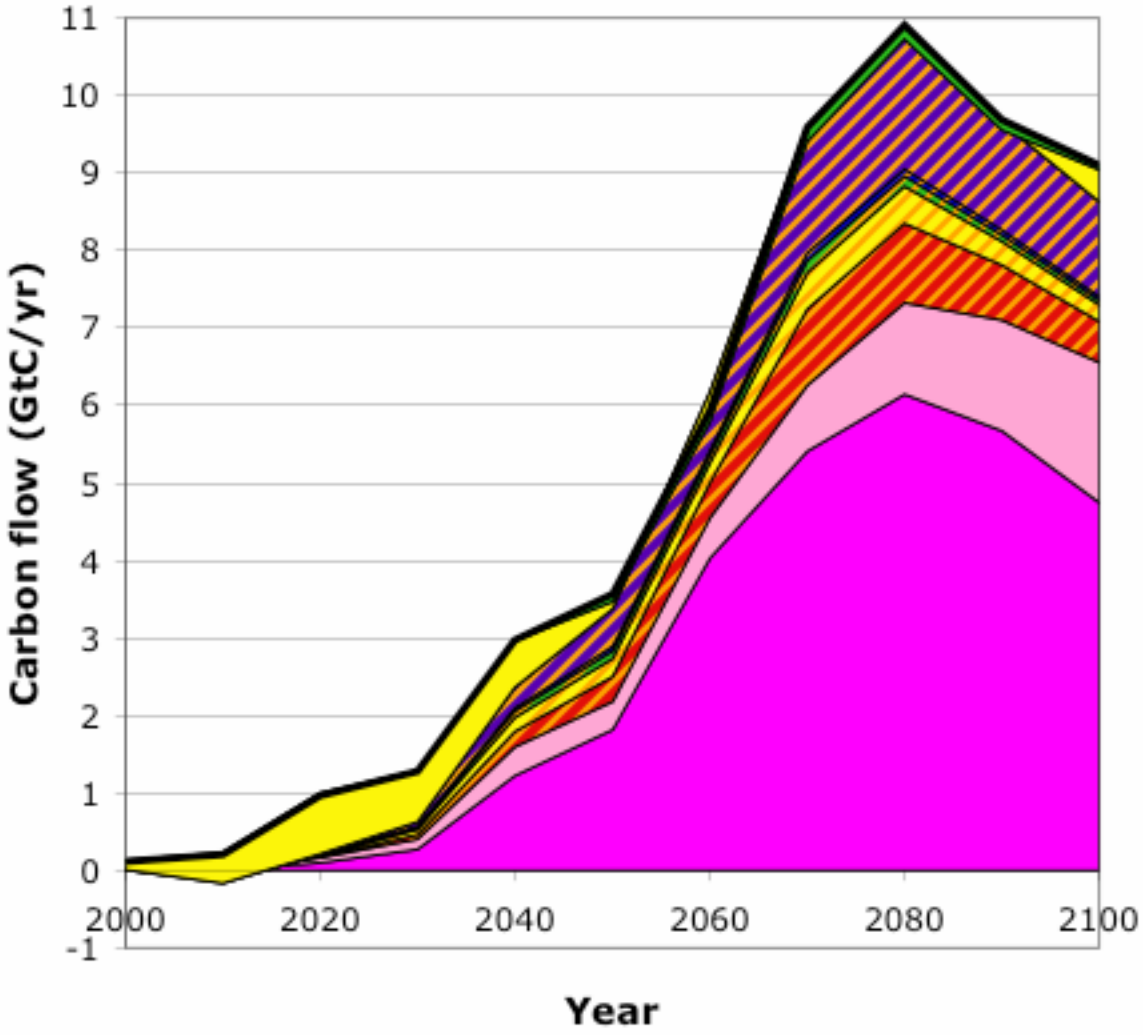
A1B, 2000-2050, by fuel



A1B, 2000-2050, by Fuel: Rich vs. Poor



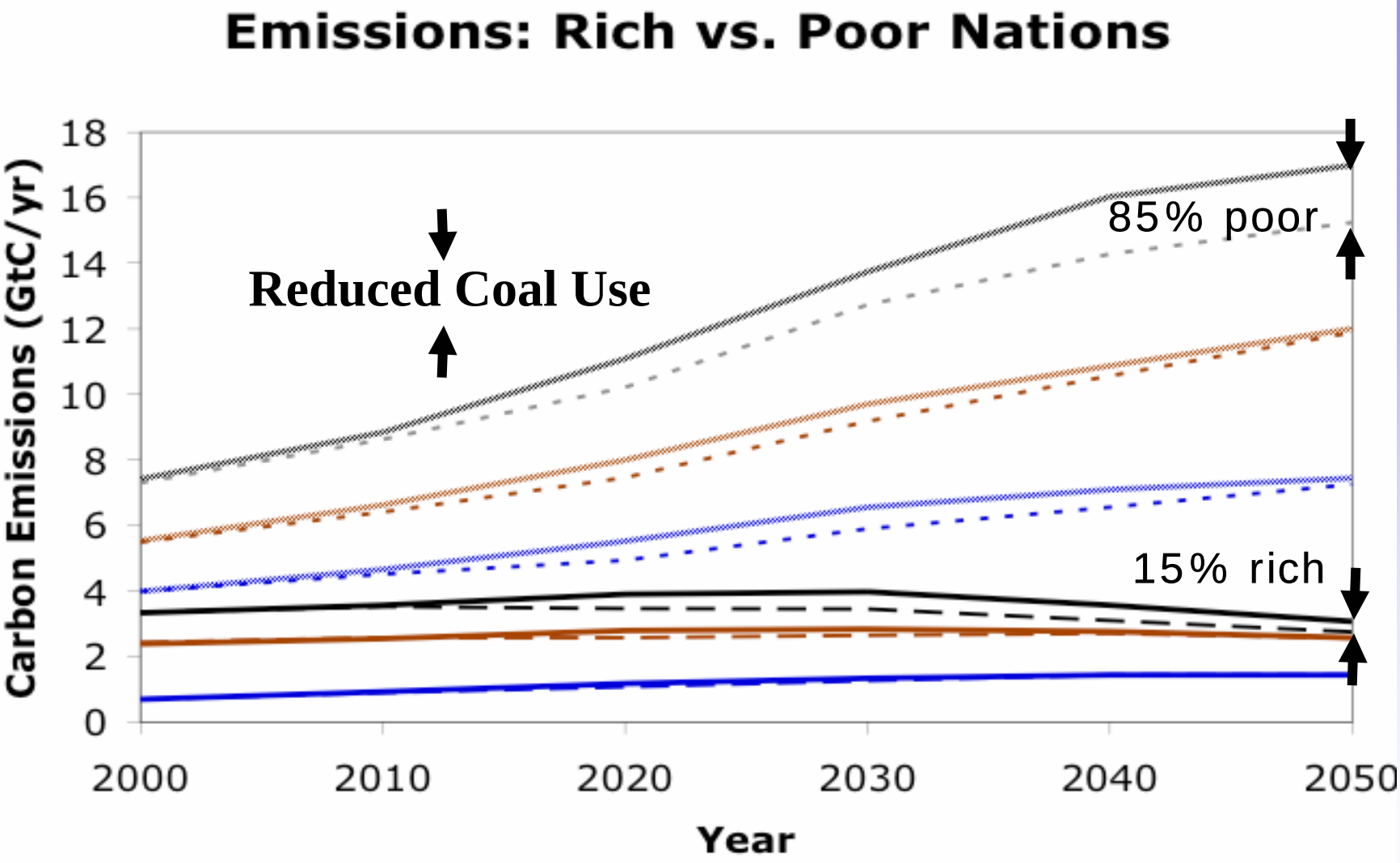
A1B vs. A1B-550 Wedges through 2100



Legend

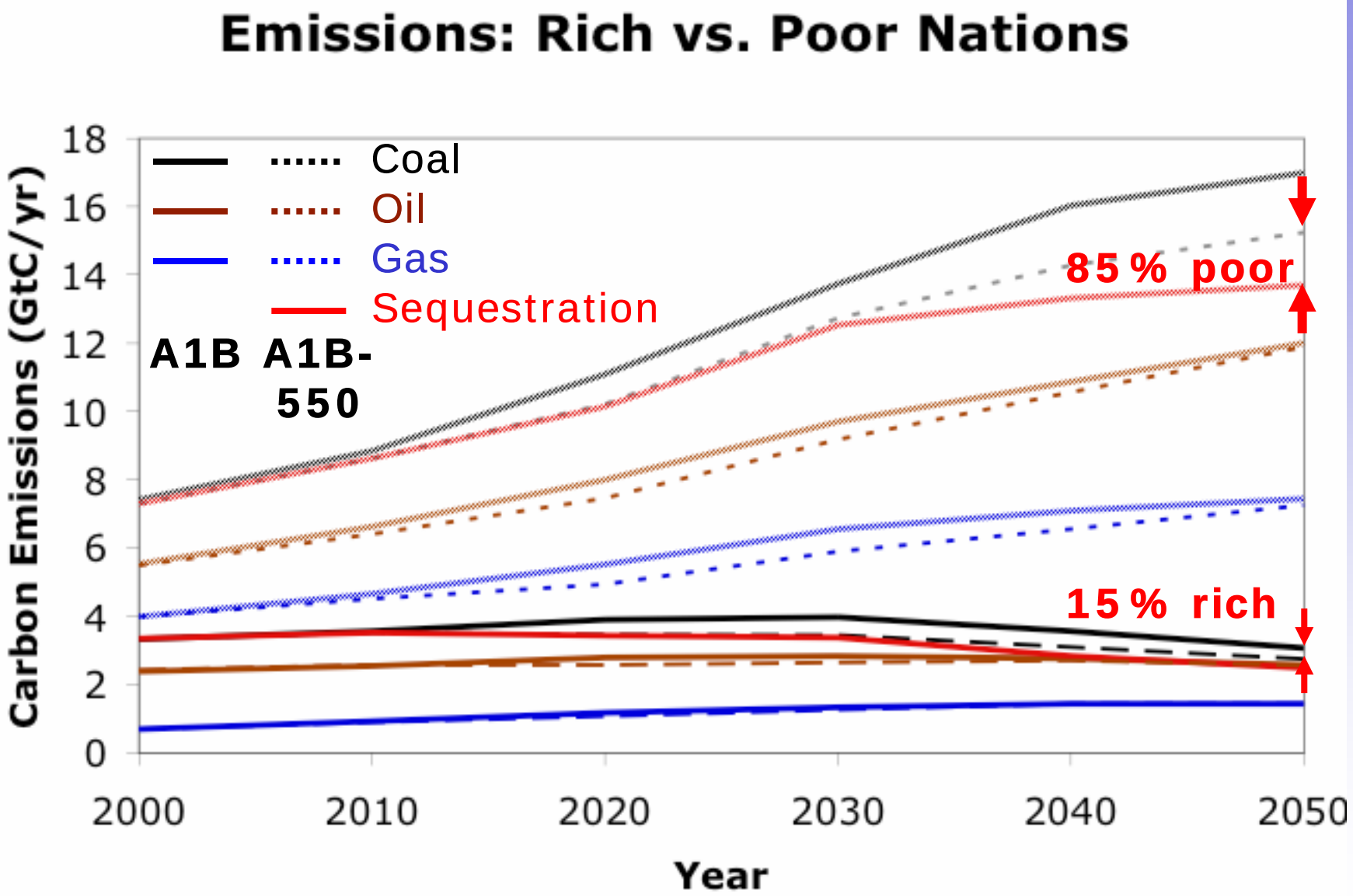
- Stabilization triangle (net)
- GWP (mex) shift
- Energy intensity shift
- Solar
- Wind
- Hydro
- Biomass
- Nuclear
- Fossil fuel carbon intensity shift
- Carbon sequestration

A1B vs A1B-550, by Fuel: Rich vs. Poor



In A1B-550, the stabilization wedges displace only coal, 85% in the poor world.

A1B vs A1B-550: Role of Sequestration



In 2050, sequestration is 85% in poor world